Developing an NER Account

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Study Purpose & Premise

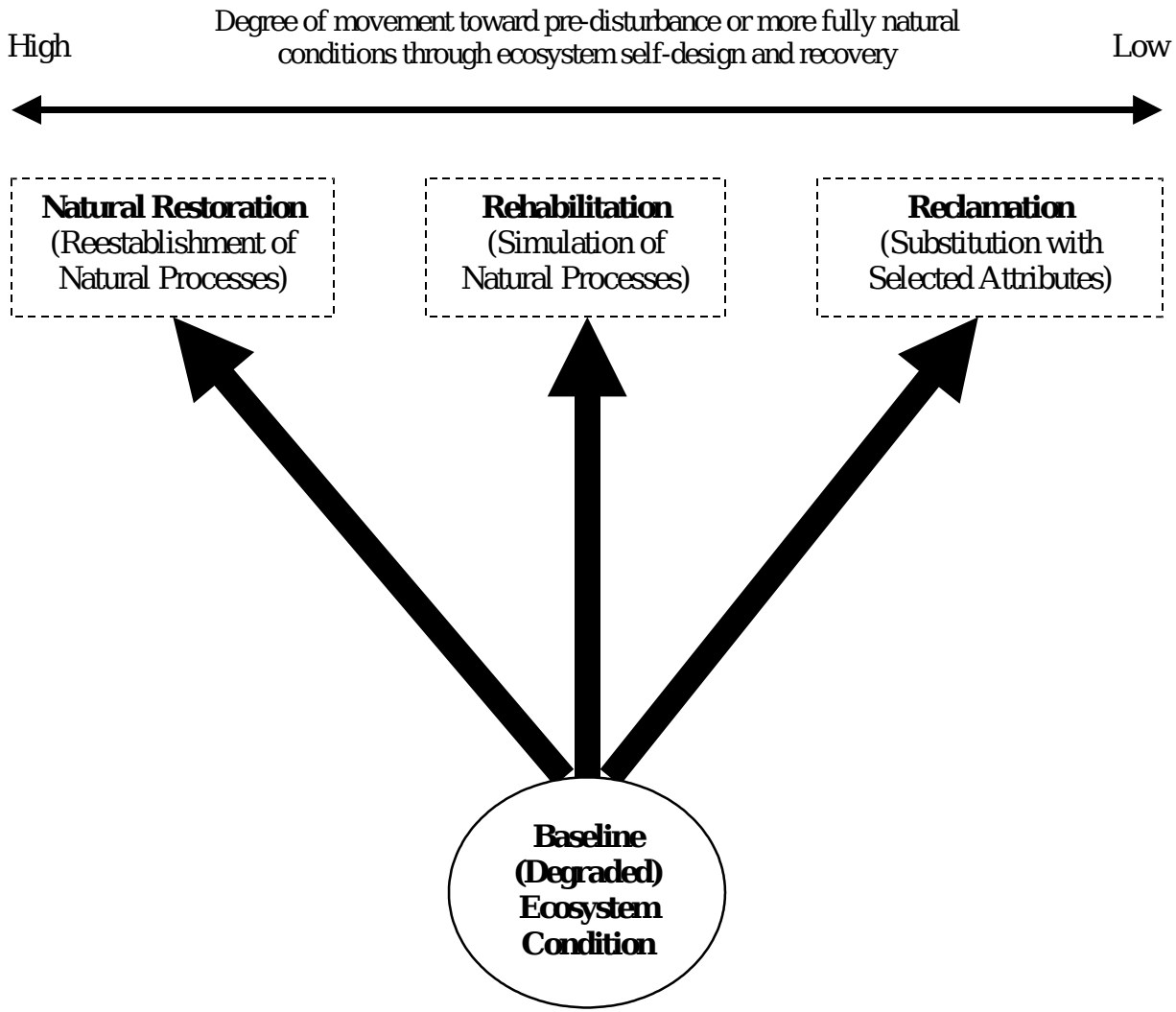
- Purpose. Investigate developing a standard conceptual & analytical framework for NER formulation/evaluation comparable to the NED framework (account) established by P&G
- Premise. Developing an NER account requires specification of the outputs to be formulated for and evaluation standards/metrics to be used for judging when a change is “better or worse”

How Does PGN Define NER?

- Federal Objective. Increases in desired resources measured as a function of improved habitat quantity/quality expressed in non-$ terms.
  - Suggests that NER mission generally is intended to serve fish & wildlife through habitat improvement
- Ecosystem Restoration Purpose. Restore degraded ecosystem structure, function & dynamic processes to a less degraded, more natural condition.
  - Suggests that NER as a formulation concept focuses on “naturalizing” ecosystems

NER as Formulation Concept

- Developing an NER account cannot move forward outside a clear understanding of restoration as a management orientation (formulation concept)
  - Some conceptions of restoration as a management orientation are bound-up with certain objectives, and thus have implications for defining & measuring NER outputs
  - At least three conceptions of restoration as a management orientation might be relevant to NER. These vary according to the emphasis placed on promoting ecosystem design & recovery from within through natural processes


High
Degree of movement toward pre-disturbance or more fully natural conditions through ecosystem self-design and recovery
Low
Natural Restoration (Reestablishment of Natural Processes)
Rehabilitation (Simulation of Natural Processes)
Reclamation (Substitution with Selected Attributes)
Baseline (Degraded) Ecosystem Condition

Conceptions of NER as Management Orientation

Hydrology & Geomorphology Drive Ecosystem Naturalness

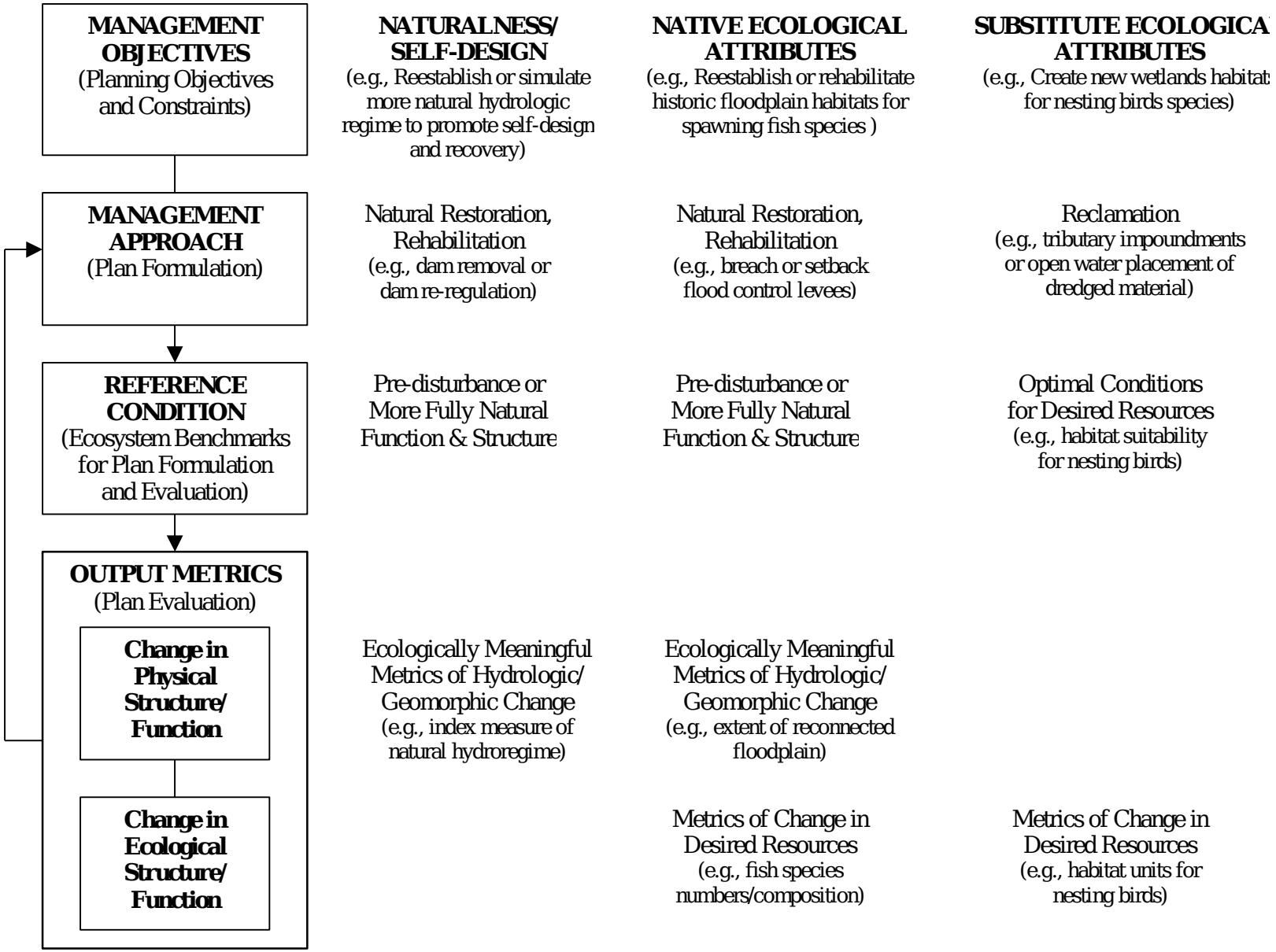
- In river-floodplain ecosystems, the natural processes of primary importance for promoting ecosystem self design & recovery of ecological resources relates to hydrology and associated geomorphology
- Ecosystem “naturalness” is driven by naturally variable flow regimes, sediment dynamics, and hydrologic connectivity between channels and historic floodplains.

Might Hydrologic/Geomorphic Output Metrics be Relevant?

- Such metrics might be appropriate for NER formulation & evaluation when:
  - Naturalness is an independent objective to be advanced by management
  - Reestablishment or simulation of more natural hydrology/geomorphology is considered necessary or best means to secure desired ecological resources
  - They are ecologically meaningful

Ecologically Meaningful Metrics of Hydrology/Geomorphology

- The applicable reference condition provides the means to identify ecologically meaningful metrics of hydrologic/geomorphic change
  - Based on records of pre-disturbance site conditions or regional areas that have been minimally altered
  - Provides template for identifying critical hydrologic/ geomorphic variables and a sense of direction for linking them to different levels of ecological recovery
  - Does not define a required hydrologic end state; rather it provides a standard by which hydrologic output metrics can be defined in terms that are ecologically meaningful.


MANAGEMENT OBJECTIVES
(Planning Objectives and Constraints)
NATURALNESS/ SELF-DESIGN
(e.g., Reestablish or simulate more natural hydrologic regime to promote self-design and recovery)
NATIVE ECOLOGICAL ATTRIBUTES
(e.g., Reestablish or rehabilitate historic floodplain habitats for spawning fish species)
SUBSITITUTE ECOLOGICA ATTRIBUTES
(e.g., Create new wetlands habitat for nesting birds species)
MANAGEMENT APPROACH
(Plan Formulation)
Natural Restoration, Rehabilitation
(e.g., dam removal or dam re-regulation)
Natural Restoration, Rehabilitation
(e.g., breach or setback flood control levees)
Reclamation
(e.g., tributary impoundments or open water placement of dredged material)
REFERENCE CONDITION
(Ecosystem Benchmarks for Plan Formulation and Evaluation)
Pre-disturbance or More Fully Natural Function & Structure
Pre-disturbance or More Fully Natural Function & Structure
Optimal Conditions for Desired Resources
(e.g., habitat suitability for nesting birds)
OUTPUT METRICS
(Plan Evaluation)
Change in Physical Structure/ Function
Ecologically Meaningful Metrics of Hydrologic/ Geomorphic Change
(e.g., index measure of natural hydroregime)
Ecologically Meaningful Metrics of Hydrologic/ Geomorphic Change
(e.g., extent of reconnected floodplain)
Change in Ecological Structure/ Function
Metrics of Change in Desired Resources
(e.g., fish species numbers/composition)
Metrics of Change in Desired Resources
(e.g., habitat units for nesting birds)

Alternative Management Objectives, Approaches & Output Metrics

Implications for Developing NER Account

- Potential to operationalize an NER account, at least in part, with hydrologic/geomorphic output metrics
- Complications and other issues
  - Output metrics will be largely site specific and driven by ecological problems of primary concern
  - Not applicable when formulation departs from natural restoration or rehabilitation of natural processes
  - Must be confidently linked to desired ecological resource outcomes
  - Continuing to document the ecological significance of costly restoration actions

Ecosystem Functions	Ecological Outputs	Demand Values
Hydrology & Sediment Dynamics • Wind, wave & flood alteration • Water flow • Water retention and delivery • Soil and sediment movement Biogeochemistry & Nutrient Cycling • Materials trapping; decomposition • Accumulation and cycling of chemical constituents • Thermodynamics; carbon cycling Habitat & Food Web Maintenance • Diversification and redundancy • Predation, disease and competition • Plant and animal production	Physical • Disturbance regulation (flood, wind, and wave) • Navigable coastlines & river channels • Water supply • Erosion control Biogeochemical • Waste treatment • Water purification • Microclimate regulation • Soil generation & fertility Biological • Biological pest control • Pollination of crops & natural vegetation • Sustenance of common fish & wildlife • Sustenance of rare fish & wildlife • Maintenance of biological diversity	Use Value in Market Production • Commercial navigation • Hydroelectric power generation • Commercial harvesting of fish, wildlife & natural products • Land productivity for agriculture • Water input for agriculture & industry Use Value in Direct Consumption • Municipal & residential water uses • Community flood & storm hazard reduction • Recreation • Aesthetics Non-Use Value • Direct utility derived from preservation of resources for which personal use is not contemplated

Components of Aquatic Ecosystem Services